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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 10/767,275 | 01/29/2004 | Ming Fu Li | IME03-009 | 4286 |

7590 06/14/2005

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| EXAMINER | |
|---|---|
| NADAV, ORI | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2811 | |

DATE MAILED: 06/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) |
|---|---|---|
| | 10/767,275 | LI ET AL |
| | Examiner | Art Unit |
| | ori nadav | 2811 |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *02 May 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-51* is/are pending in the application.

4a) Of the above claim(s) *11-51* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *19 January 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *4/15/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

### *Election/Restrictions*

Applicant's election with traverse of the embodiment of figure 7 in the reply filed on 05/02/2005 is acknowledged. The traversal is on the ground(s) that the field of search for both groups I and II is co-extensive, and the examiner's suggestion for an alternative method of forming the device is speculative and has nothing to do with the claims as presented in this patent application. Applicant further argues that the examiner is respectfully requested to reconsider the Requirement for Election of Species given in the Office Action, because of the increased costs applicant would be forced to bear if the three species are separately examined.

This is not found persuasive because the criteria to determine whether the inventions are distinct from one another is if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEQ 806.05(9)). In the instant case unpatentability of Group II invention would not necessarily imply unpatentability of the process of the group II invention, since the device of group I invention could be made by processes different from those of group II invention, as suggested by the examiner.

Furthermore, examination of three separate and distinct inventions creates serious burden on the examiner.

The requirement is still deemed proper and is therefore made FINAL.

### *Claim Objections*

Claims 1-10 are objected to because of the following informalities: The phrases "a quantum well layer" and "a tunneling barrier layer", as recited in claim 1, should read "quantum well layers" and "tunneling barrier layers", respectively. Appropriate correction is required.

### *Claim Rejections - 35 USC § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 3 and 10 are rejected under 35 U.S.C. 102(b) as being anticipated by Krivokapic (6,291,832).

Krivokapic teaches in figure 5 and related text a resonant tunneling diode (RTD) using low band offset dielectric material as double barrier layers and having a vertical layer configuration comprising:

a substrate having a substantially planar horizontal surface;

a horizontally disposed configuration of vertical layers formed on said substrate, said layers being perpendicular to said horizontal surface, said configuration further comprising:

a quantum well layer 204 formed of a semiconductor material, said layer being vertical, having parallel planar vertical sides and being formed to a first thickness;

a tunneling barrier layer 208 formed on each side of said quantum well layer, each said barrier layer being formed, to a second thickness, of a dielectric material characterized by a low band offset relative to the conduction band edge of said semiconductor material; and

an adjacent conducting contact layer 206 being formed on each said tunneling barrier layer,

wherein said quantum well layer is oriented so that its vertical sides are any preferred crystallographic plane, and

wherein said substrate is a SOI, GOI or SiGe-on oxide substrate and wherein an isolating layer is interposed between said substrate and said horizontally disposed configuration.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 2 and 4-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krivokapic.

Regarding claim 2, Krivokapic teach substantially the entire claimed structure, as applied to claim 1 above, except a quantum well semiconductor material being monocrystalline Si, Ge or SiGe.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a quantum well semiconductor material being monocrystalline Si, Ge or SiGe in Krivokapic's device in order to improve the characteristics of the device, since the advantages of a single crystal silicon are well known in the art, of which official notice is taken.

Regarding claim 4, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a low band offset dielectric material being a high-k dielectric material Si3N4, Hfo2, ZrO2, Y2O3, Pr2O3, TiO2, Al2O3, or Ta2O5, or their alloys or laminates in Krivokapic's device in order to improve the characteristics of the device. Note that substitution of materials is not patentable even when the substitution is new and useful. Safetran Systems Corp. v. Federal Sign & Signal Corp. (DC NIII, 1981) 215 USPQ 979.

Regarding claims 5, 7 and 8, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to form the dielectric material to a second thickness of between approximately 0.5 nm and 5.0 nm, to form the silicon quantum well layer to a first thickness between approximately 2 nm and 25 nm, and to dope the silicon quantum well layer with either n-type or p-type doping to a dopant concentration

between approximately El6 and E19 cm(-3) in Krivokapic's device in order to improve the characteristics of the device, subject to routine experimentation and optimization. When the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller , 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). Applicant can rebut a prima facie case of obviousness based on overlapping ranges by showing unexpected results or the criticality of the claimed range. "The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims . . . . In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." In re Woodruff , 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). See MPEP § 716.02 - § 716.02(g) for a discussion of criticality and unexpected results.

Regarding claims 6 and 7, prior art teaches a quantum well layer being in a crystallographic planes of 100, 110 or 111 crystallographic planes, wherein the quantum well layer is characterized by at least one electron bound state and associated bound state energy.

Regarding claim 9, it is conventional to reverse the polarity of the device. Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to a conducting layer of n+ doped polysilicon, as claimed.

***Conclusion***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Reference B is cited as being related to an RTD device..

**Papers related to this application may be submitted to Technology center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the TC 2800 Fax center located in Crystal Plaza 4, room 4-C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The Group 2811 Fax Center number is (703) 308-7722 and 308-7724. The Group 2811 Fax Center is to be used only for papers related to Group 2811 applications.**

Any inquiry concerning this communication or any earlier communication from the Examiner should be directed to *Examiner Nadav* whose telephone number is **(571) 272-1660**. The Examiner is in the Office generally between the hours of 7 AM to 4 PM (Eastern Standard Time) Monday through Friday.

Any inquiry of a general nature or relating to the status of this application should be directed to the **Technology Center Receptionists** whose telephone number is **308-0956**

O.N.
6/8/05

ORI NADAV
PRIMARY EXAMINER
TECHNOLOGY CENTER 2800